

Pacific University

CommonKnowledge

---

School of Physician Assistant Studies

College of Health Professions

---

Summer 8-11-2018

## Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention

Adam Stapleton

### Recommended Citation

Stapleton, Adam, "Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention" (2018).  
*School of Physician Assistant Studies*. 651.  
<https://commons.pacificu.edu/pa/651>

This Capstone Project is brought to you for free and open access by the College of Health Professions at CommonKnowledge. It has been accepted for inclusion in School of Physician Assistant Studies by an authorized administrator of CommonKnowledge. For more information, please contact [CommonKnowledge@pacificu.edu](mailto:CommonKnowledge@pacificu.edu).

---

# Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention

## Abstract

|| Abstract ||

**Background:** Approximately one-third of people aged 65 years and over who are not living in institutions fall at least once a year, with higher rates among those living in institutions. One half of older adults who are hospitalized as a result of a fall survive one year later. The importance of fall prevention in older adults is well researched, with many established community based programs in the United States focusing on exercise and fundamental education for fall reduction. However, new options for prevention are being explored. Executive function and gait, both related to falls, may be improved by methylphenidate, providing a promising option for fall prevention in older adults.

**Methods:** An exhaustive literature search using MEDLINE-PubMed, Web of Science, and Clinical Key was conducted. The following search terms were used: "methylphenidate falls prevention," "methylphenidate older adults," and "falls prevention methylphenidate." Eligibility criteria were used to screen studies. These studies included the use of single dose methylphenidate versus placebo to measure efficacy in falls prevention. GRADE was used to assess quality of the resulting studies.

**Results:** Two studies were included in this systematic review, meeting the inclusion and exclusion criteria. One study was a double-blind RCT in 30 healthy older adults testing improvement of executive, motor and balance function. Another study in 26 older adults without dementia but with subjective complaints of memory problems tested the modification of markers for fall risk. These studies have medium quality of evidence based on GRADE guidelines.

**Conclusion:** These studies found that methylphenidate improved gait and executive function in older adults, and should be considered by clinicians as a method of fall prevention in this population. These results warrant further investigation of methylphenidate use in fall prevention with large-scale studies.

**Keywords:** *Methylphenidate, older adults, and fall prevention*

## Degree Type

Capstone Project

## Degree Name

Master of Science in Physician Assistant Studies

## Keywords

methylphenidate, older adults, fall prevention

### Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the "Rights" section on the previous page for the terms of use.

**If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:**

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see "Rights" on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to: [copyright@pacificu.edu](mailto:copyright@pacificu.edu)

# **Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention**

Adam Stapleton



*A Clinical Graduate Project Submitted to the Faculty of the*

*School of Physician Assistant Studies*

*Pacific University*

*Hillsboro, OR*

*For the Masters of Science Degree, August 2018*

*Faculty Advisor: Annjanette Sommers, PA-C, MS*

*Clinical Graduate Project Coordinator: Annjanette Sommers, PA-C, MS*

## **Biography**

Adam Stapleton is a native of North Carolina where he worked for the North Carolina Center for Health and Wellness as the Community Collaboration Assistant and majored in Health and Wellness Promotion at UNC Asheville. After completion of his undergraduate degree, he moved to New Orleans to work as a Certified Nursing Assistant and Skilled Nursing Lifestyles Coordinator. Career goals include working in Family Practice and Emergency Medicine with MUA/P and HPSA designated facilities.

## **|| Abstract ||**

**Background:** Approximately one-third of people aged 65 years and over who are not living in institutions fall at least once a year, with higher rates among those living in institutions. One half of older adults who are hospitalized as a result of a fall survive one year later. The importance of fall prevention in older adults is well researched, with many established community based programs in the United States focusing on exercise and fundamental education for fall reduction. However, new options for prevention are being explored. Executive function and gait, both related to falls, may be improved by methylphenidate, providing a promising option for fall prevention in older adults.

**Methods:** An exhaustive literature search using MEDLINE-PubMed, Web of Science, and Clinical Key was conducted. The following search terms were used: “methylphenidate falls prevention,” “methylphenidate older adults,” and “falls prevention methylphenidate.” Eligibility criteria were used to screen studies. These studies included the use of single dose methylphenidate versus placebo to measure efficacy in falls prevention. GRADE was used to assess quality of the resulting studies.

**Results:** Two studies were included in this systematic review, meeting the inclusion and exclusion criteria. One study was a double-blind RCT in 30 healthy older adults testing improvement of executive, motor and balance function. Another study in 26 older adults without dementia but with subjective complaints of memory problems tested the modification of markers for fall risk. These studies have medium quality of evidence based on GRADE guidelines.

**Conclusion:** These studies found that methylphenidate improved gait and executive function in older adults, and should be considered by clinicians as a method of fall prevention in this population. These results warrant further investigation of methylphenidate use in fall prevention with large-scale studies.

**Keywords:** *Methylphenidate, older adults, and fall prevention*

## **Acknowledgements**

To my wife and family: Thank you for your endless support and willingness to join me on this journey. Thank you for reminding me to enjoy the process. Most of all, thank you for your kindness and service to others from which I draw motivation to be better each and every day.

## Contents

Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention.....	1
[Student Name] .....	1
Biography .....	2
Abstract    .....	3
Acknowledgements .....	4
List of Tables .....	6
List of Abbreviations .....	6
Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention.....	7
BACKGROUND .....	7
METHODS .....	8
RESULTS .....	9
DISCUSSION .....	15
CONCLUSION .....	16



## List of Tables

Table 1:	Quality Assessment of Reviewed Studies
Table 2:	Ben-Itzak et al Summary of Findings
Table 3:	Shorer et al Summary of Findings
Table 4:	Shorer et al Summary of Findings

## List of Abbreviations

EF	Executive Function
RCT	Randomized Controlled Trial
MPH	Methylphenidate
GRADE	Grading of Recommendations Assessment, Development and Evaluation
MMSE	Mini Mental State Exam
TUG	Timed Up and Go
CV	Coefficient of Variation
ST	Single Task
DT	Dual Task
NBWT	Narrow Base Walk Test

# **Efficacy of Methylphenidate in the Geriatric Population for Fall Prevention**

## **BACKGROUND**

Approximately one-third of people aged 65 years and over who are not living in institutions fall at least once a year, with higher rates among those living in institutions.<sup>1</sup> One half of older adults who are hospitalized as a result of a fall survive 1 year later.<sup>2</sup> The importance of fall prevention in older adults is well researched, with many established community based programs in the United States focusing on exercise and fundamental education for fall reduction. While these are key components in fall prevention, there are other areas that can be addressed. According to a study from 2016, direct medical costs in 2015 for fatal falls totaled \$637.5 million, and \$31.3 billion for non-fatal fall related injuries among adults over the age of 65. Total cost and fall incidence are found to increase with age.<sup>3</sup>

Methylphenidate (MPH) works as a mild central nervous system (CNS) stimulant. It blocks the re-uptake of norepinephrine and dopamine into presynaptic neurons and appears to stimulate the cerebral cortex and subcortical structures similar to amphetamines.<sup>4</sup> It is postulated that the resulting MPH-induced increases of dopamine and norepinephrine could decrease distractibility, improve attention and enhance the saliency of tasks due to dopamine's modulation of motivation, thus improving performance.<sup>5</sup>

Deterioration in balance and gait related to age is a significant contributor to falls in older adults.<sup>6</sup> Simultaneous performance of a motor or cognitive task is an additional

factor that may limit balance control in older adults.<sup>6</sup> Executive function (EF) refers to higher cognitive processes that use and modify information from posterior cortical sensory systems to modulate behavior, to regulate response inhibition, and to allocate attention among tasks that are performed simultaneously.<sup>7</sup> Gait utilizes EF, and these age related changes in cognition have ramifications for mobility in older adults.<sup>8</sup>

Studies of EF improvement were motivated by an earlier study<sup>9</sup> where single dose MPH improved gait (e.g. stride time variability), mobility (e.g. Timed Up and Go times), and EF (e.g., Go-NoGo accuracy) in relatively healthy older adults. A study conducted by Moreau and colleagues<sup>10</sup> on patients with advanced Parkinson's disease who suffered from severe gait disorders and freezing of gait, found that MPH improved gait freezing and hypokinesia despite the optimal treatment of motor fluctuations with subthalamic stimulation and dopaminergic drugs. Decreased EF has been linked to reduced mobility, gait instability and the markers of fall risk, but it is unknown if augmenting EF will affect fall risk or gait.<sup>8</sup>

While MPH is indicated and a proven treatment option in the geriatric population for ADHD, narcolepsy, and major depressive disorder, there are no indications for fall prevention.<sup>4</sup> It shows promise, so can single dose methylphenidate be used safely and effectively as a method of fall prevention in older adults?

## **METHODS**

An exhaustive literature search using MEDLINE-PubMed, Web of Science, and Clinical Key was conducted. The following search terms were used: “methylphenidate falls prevention,” “methylphenidate older adults” and “falls prevention methylphenidate.”

Sources used in these studies were examined for accuracy and used if relevant. Inclusion and exclusion criteria were applied to analyze each study. Studies evaluating the use of single dose methylphenidate versus placebo to measure efficacy in fall prevention were included. Studies were excluded if they were not a double-blinded RCT. Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group guidelines was used to assess quality of the resulting studies.<sup>11</sup>

## RESULTS

Initial searches resulted in 146 studies for review. After reading titles and abstracts, 2 studies<sup>8,17</sup> were selected that met eligibility criteria. Both of these studies are RCTs in the older adult population, measuring single dose MPH vs. placebo, and 1 is a cross-over study.<sup>8</sup> (See Table 1.)

### **Ben-Itzhak et al**

This study<sup>8</sup> was a double blinded, randomized, placebo-controlled, cross-over study using single-dose MPH vs. placebo. The authors wanted to look at whether or not MPH modifies risk markers of fall risk in older adults. The study took place in an outpatient movement disorders clinic and included 26 older adults, mean age of 73.8 years, with subjective complaints of “memory problems” but who were non-demented. Using the Mini Mental State Examination (MMSE), DSM IV and ICD-10 criteria, people with dementia were excluded from the study. Due to MPH’s side effect profile, subjects were excluded if they had uncontrolled high BP, heart failure or cardiac arrhythmia, cardiovascular or respiratory diseases, history of epilepsy, glaucoma, major depression, Parkinson’s disease, or other neurodegenerative diseases.<sup>8</sup>

During the first visit, medical and fall history were reviewed to characterize the study population in combination with certain tests that were administered. The Geriatric Depression Scale (GDS) to evaluate emotional well being and depressive symptoms, the clock drawing test to measure cognitive function, the Charlson Comorbidity Index to quantify disease burden, the Barthel Activities of Daily Living Index and the French Activities Index to characterize disability and lifestyle and functional independence, and the Activities-specific Balance Confidence Scale to assess fear of falling. As part of the cognitive assessment, the MMSE was used to screen for dementia.<sup>8</sup>

The course of the study was 2 weeks, with the initial visit for baseline, then 2 more evaluations each 2 hours after subjects took 20mg MPH (Ritalin®) or placebo. The Timed Up and Go (TUG) test was used to assess fall risk and functional mobility, with the second of 2 trials being used as per standard procedures to minimize practice effects. Stride time variability, which quantifies automaticity of gait, was evaluated by having the subjects walk their normal pace on level ground for 2 minutes while wearing pressure-sensitive insoles.<sup>8</sup> Dual-task methods that were previously established<sup>12-13</sup> were used to measure gait speed, stride time and variability to stride time using the coefficient of variation (CV). A high CV value signifies reduced rhythmicity and automaticity, which are associated with elevated fall risk.<sup>12-13</sup>

The Go-NoGo test was used to measure EF, a well-established cognitive test that measures the means with which an individual is able to continue with an activity in the face of competing stimuli and to inhibit a response.<sup>14</sup> Reaction time in the Go-NoGo was measured to evaluate stimulant effects, and the accuracy of each test was evaluated to

quantify EF.<sup>8</sup> In order to evaluate possibility of observed motor effects being specific to gait, catching and finger tapping abilities were measured. In this computerized game,<sup>15</sup> participants catch an object falling vertically from the top of the computer screen, testing hand-eye coordination and scanning. Outcome measures of this test have been associated with higher-level cognitive function and EF.<sup>16</sup>

Statistical analysis revealed that TUG times decreased compared to baseline ( $P = 0.004$ ) and compared to the effect seen with placebo ( $P = 0.03$ ) on 20mg MPH. Stride time variability was significantly improved on MPH compared to baseline ( $P = 0.28$ ), but not compared to placebo ( $P = 0.551$ ). MPH was also shown to significantly improve Go-NoGo accuracy from baseline ( $P = 0.030$ ), and above the placebo effect ( $P = 0.027$ ). MPH also improved catch game accuracy ( $P = 0.044$ ) and catch game time to first move ( $P = 0.034$ ), while the placebo did not. Similar effects on Go-NoGO reaction time were recorded in both MPH and placebo groups.<sup>8</sup> (See Table 2)

Limitations of this study include the size of the study population, which only had 26 subjects. The number of subjects, in addition to subject characteristics, raises questions regarding the generalizability of the findings. The length of the study was only 2 weeks, which may also limit its application. Chronic administration of MPH was not evaluated in lowering fall rates, whether the administered dose is optimal, or whether the potential benefits outweigh the possible risks. Adverse events were not observed in this study, but safe administration of MPH in older adults needs to be further investigated.<sup>8</sup>

**Shorer et al**

This was the most recent study,<sup>17</sup> a double-blinded, RCT using single dose MPH (Group X) vs. placebo. This study was motivated by the evidence for benefits of MPH for divided attention and on the fact that MPH may improve EF, which generally declines with aging.<sup>18</sup> The authors wanted to test the hypothesis that administering a single dose of MPH will improve gait and postural stability of older adults in both single-task (ST) and dual-task (DT) conditions. This study was conducted at the University of Negev, Beer-Sheeva, Israel, and included 30 healthy older adults with a mean age of 74.9 years. Exclusion criteria included inability to walk independently at least 20 meters, serious visual impairment, severe peripheral or compression neuropathies, symptomatic cardiovascular, musculoskeletal or neurologic disorders that may interfere with gait, being under the active treatment of cancer and a score lower than 24 on MMSE.<sup>17</sup>

After completion of the baseline visit, subjects were given either 10mg MPH or placebo in a randomized, double blinded fashion and given a 1.5 hour break to allow peak plasma concentration. The postural stability protocol started by having participants stand upright on a force platform, a Kistler 9287 single force platform, which measures the time-varying displacement of the center of pressure (CoP) under a participant's feet. Fourteen 30-second trials were conducted for 2 task conditions. Two task conditions included 7 ST trials, which had participants stand upright with eyes closed and blindfolded, and 7 DT trials, where participants were similarly standing upright and blindfolded but also required to perform a memory attention-demanding task. These attention-demanding tasks during DT trials included listening to a collection of 15 words, one word every 2 seconds, with the instruction of counting the number of words that did not start with a

certain letter while standing still. After completion of a trial, they would recall the number of words they counted that did not start with that particular letter. Participants were allowed to practice the trials beforehand, and were not given specific attention focus instructions.<sup>17</sup>

Force platform data were sampled at 100 Hz frequency and analyzed using automatic code written in Matlab (Math Works Inc, Cambridge, MA), to obtain 4 well established parameters of postural stability. These parameters included mediolateral (ML) CoP range, anteroposterior (AP) CoP range, mean velocity of CoP sway, and sway area-elliptical area of the CoP points. Each participant's trials were computed and averaged for each set of 7 trials to get an average value for each parameter in each experimental condition for each participant.<sup>17</sup>

After a 10-minute break, the narrow base walk test (NBWT)<sup>19</sup> was modified for clinical use and used to measure gait under ST and DT conditions, which required participants to walk down a 6m narrow path for 6 trials. There were 3 different types of cognitive tasks, saying the day of the week backwards in the first trial, the months of the year backwards in the second trial, and to count down in increments of 5 from 100 to 50 in the third trial. Video of trials was later analyzed for trial times, detected steps errors, calculated step error rate, number of steps, and calculated trail velocity. All NBWT parameters of participant's trials were averaged for each set of 3 trials to obtain average values of each participant in ST and DT conditions.<sup>17</sup>

Statistical analysis found a significant Group X Time interrogation in AP sway range in DT condition ( $F = 1.7$ ,  $P = .05$ ), indicating significantly improved stability in the



experimental group with small effect size during DT and not during ST. There was also a significant main effect for time in ML sway range, mean velocity, and sway area during DT condition ( $F = 6.4, P = .016$ ;  $F = 19.6, P = .001$ ; and  $F = 10.6, P = .003$ , respectively) and in mean velocity and sway area during ST condition ( $F = 4.5, P = .04$  and  $F = 4.0, P = .05$ , respectively), driven by improvement over time in both study groups. A 57% reduction in the number of step errors in the experimental group, and no equivalent improvement in place controls was reported. In the experimental group's number of step errors, a significant Group X Time interaction was found in the ST condition ( $F = 4.5, P = .04$ ). In the DT condition, significant Group X Time interaction effect was found for trial velocity, number of step errors, and trial time after taking MPH ( $F = 5.2, P = .04$ ;  $F = 5.7, P = .02$ ; and  $F = 6.1, P = .02$ , respectively). In addition, the study revealed a significant Group X Time interaction effect for all 3 variables representing motor performance in the third trial; trial velocity, trial time, and number of steps improved in the experimental group only ( $F = 7.4, P = .009$ ;  $F = 6.7, P = .01$ ; and  $F = 9.7, P = .004$ , respectively), which shows that in the trials with MPH treatment, a learning effect occurred. No significant interaction effect between group and time or significant main effect for time was observed for the cognitive task error rate during postural stability and NBWT in ST or DT conditions.

<sup>17</sup> (See Tables 3 & 4)

Limitations of this study include the sample size, which is only 30 older adults pooled from a defined relatively healthy community-based population. The study has strict health inclusion criteria, which excludes application of results to extremely weak or institutionalized older adults. A confounder was introduced into the design of the experi-

ment from the easier work monitoring cognitive task during the standing trials and the fluency tasks during the gait trials. Also, one cannot make strong conclusions about the relative efficacy of drug treatment effects for DT balance versus walking, due to passive word monitoring not requiring EFs as much as fluency.<sup>17</sup>

## **DISCUSSION**

Rates of falling among older adults continue to rise despite prevention efforts in the US. The components of preventing falls in these programs are primarily awareness, physical strengthening and maintaining activity levels. Though these intervention programs are effective, alternative options can be explored. The focus of this systematic review was to determine efficacy of MPH as a reliable means to prevent falls in older adults.

The results of the reviewed studies<sup>8,17</sup> both show a positive correlation between low, single-dose MPH and improvement in gait and EF. Though the use of this medication for fall prevention is not established, these studies provide evidence of improvement in key components of falls that can make a difference in preventing falls in older adults. Providers may want to consider the use of MPH in fall prevention, particularly in patients who may not adhere to other manners of prevention.

These 2 studies were assessed using GRADE criteria, and both only scored with low quality (Table 1). Additional limitations in one study<sup>8</sup> includes: subjects were healthy relative to their age with strict inclusion criteria, and needed to ambulate without assistance to be a study participant. This may limit application to groups outside of this cat-

egory of older adults. Though dementia was ruled out with MMSE, participants also had subjective complaints of “memory problems” which is broad and not specific. Another study<sup>17</sup> did not provide the method of recruitment, which could indicate selection bias, and did not measure adverse side effects during the study. Also, this study’s trials took place in a single day, limiting long term application. Both studies had a small sample size, which does not ensure that the results can be generalized to a larger population. Despite the limitations of these studies, they both provide a basis for further studies.

The premise of prevention would mean long term treatment with MPH, and this means that larger studies, with more variance in participants are needed. One reason for strict inclusion and exclusion criteria in these studies is due to known side effects of MPH. Increasing heart rate and blood pressure in older adults is far from ideal. However, no adverse events were recorded during the first study,<sup>8</sup> with no increases in systolic blood pressure, diastolic blood pressure, or heart rate. Though this study only took place over 2 weeks, so this warrants a longer study with MPH.

With MPH being used in the geriatric population for narcolepsy, ADHD and MDD, even with the side effects taken into consideration, then perhaps it should be considered as a viable option in fall prevention treatment. By improving gait and executive function, prevention of falls with methylphenidate could reduce the number of hospitalizations, burden to health care systems such as the annual \$32 billion in direct medical costs and prevent morbidity related to falls in this population.

## **CONCLUSION**

MPH was able to improve gait function in healthy older adults, especially in complex tasks that require higher executive control. Measures of gait and EF showed improvement in groups taking MPH compared to placebo in both studies. There are a number of limitations in these studies, but the results provide a foundation for a large scale study to solidify MPH's use as a fall prevention medication in older adults. The cost of falls to the medical system, and potential for improvement in quality of life for older adults warrants a larger scale study.

Clinicians should continue with traditional fall prevention methods that focus on exercise and balance, and consider the future use of MPH as an alternative treatment once large scale studies have been conducted that demonstrate efficacy and with more generalized applications to older adults. There is promise in this drug's ability to aid in improvement in the quality of life for the geriatric population.

## **References**

1. Stalenhoef PA, Crebolder HFJ, Knottnerus JA, van der Horst FGE. Incidence, risk factors and consequences of falls among elderly subjects living in the community: a criteria-based analysis. *Eur J Public Health*. 1997;7:328-334.
2. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. *Age Ageing*. 2006;35(Suppl 2):ii37–ii41.
3. Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults — United States. *Journal of Safety Research*. 2016;58:99-103.

4. Savarese DMF, Zand J. Methylphenidate: Drug information. In: Zand J, ed. *UpToDate* Waltham, Mass.: UpToDate; [www.uptodate.com](http://www.uptodate.com). Accessed March 10, 2018.
5. Volkow ND, Fowler JS, Wang G, Ding Y, Gatley SJ. Mechanism of action of methylphenidate: Insights from PET imaging studies. *J Atten Disord*. 2002;6:31-43.
6. Melzer I, Benjuya N, Kaplanski J. Age-related changes of postural control: effect of cognitive tasks. *Gerontology*. 2001;47:189–194.
7. Lezak MD. Neuropsychological assessment. New York: Oxford University Press, Inc; 1995.
8. Ben-Itzhak R, Giladi N, Gruendlinger L, Hausdorff JM. Can methylphenidate reduce fall risk in community-living older adults? A double-blind, single-dose cross-over study. *J Am Geriatr Soc*. 2008;56:695-700.
9. Auriel E, Hausdorff JM, Herman T, et al. Effects of methylphenidate on cognitive function and gait in patients with Parkinson's disease: a pilot study. *Clin Neuropharmacol*. 2006;29:15–17.
10. Moreau C, Delval A, Defebvre L, et al. Methylphenidate for gait hypokinesia and freezing in patients with Parkinson's disease undergoing subthalamic stimulation: a multicentre, parallel, randomised, placebo-controlled trial. *Lancet Neurol*. 2012;11:589–596.
11. GRADE working group. GRADE website. <http://gradeworkinggroup.org/>. Accessed July 23, 2017.
12. Springer S, Giladi N, Peretz C, et al. Dual-tasking effects on gait variability: the role of aging, falls, and executive function. *Mov Disord*. 2006;21:950–957.

13. Yogev G, Giladi N, Peretz C, et al. Dual tasking, gait rhythmicity, and Parkinson's disease: Which aspects of gait are attention demanding? *Eur J Neurosci.* 2005;22:1248–1256.
14. Riccio CA, Reynolds CR. Continuous performance tests are sensitive to ADHD in adults but lack specificity. A review and critique for differential diagnosis. *Ann N Y Acad Sci.* 2001;931:113–139.
15. Dwolatzky T, Whitehead V, Doniger GM, et al. Validity of a novel computerized cognitive battery for mild cognitive impairment. *BMC Geriatr.* 2003;3:4.
16. Hausdorff JM, Yogev G, Springer S, et al. Walking is more like catching than tapping: gait in the elderly as a complex cognitive task. *Exp Brain Res.* 2005;164:541–548.
17. Shorer Z, Bachner Y, Guy T, Melzer I. Effect of single dose methylphenidate on walking and postural stability under single- and dual-task conditions in older adults--a double-blind randomized control trial. *J Gerontol A Biol Sci Med Sci.* 2013;68:1271-1280.
18. Verhaeghen P, Cerella J. Aging, executive control, and attention: a review of meta-analyses. *Neurosci Biobehav Rev.* 2002;26:849–857.
19. Kelly VE, Schrager MA, Price R, Ferrucci L, Shumway-Cook A. Age-associated effects of a concurrent cognitive task on gait speed and stability during narrow-base walking. *J Gerontol A Biol Sci Med Sci.* 2008;63:1329–1334.

<b>Table 1: Quality Assessment of Reviewed Articles</b>									
Outcome	Number of studies	Study Designs	Downgrade Criteria					Upgrade Criteria	Quality
			Limitations	Indirectness	Inconsistency	Imprecision	Publication bias		
Gait Improvement	2	RCTs	Serious (1,2)	Serious (3)	Not Serious	Not Serious	Unlikely	None	Low
Executive Function improvement	2	RCTs	Serious (1,2)	Serious (3)	Not Serious	Not Serious	Unlikely	None	Low
1: Both studies have small sample sizes, and were conducted over short periods of time. These studies were not long enough to measure adverse side effects from long term use. 2: One study does not list recruiting methods, which could mean selection bias. 3: Studies used surrogate outcomes									

<b>Table 2: Ben-Itzak et al<sup>8</sup></b>				<b>P-values</b>		
	<b>Baseline/ Unmedicat ed</b>	<b>MPH</b>	<b>Placebo</b>	<b>Baselines vs. MPH</b>	<b>Baseline vs. Placebo</b>	<b>MPH vs. Placebo</b>
<b>Gait speed (m/sec)</b>	1.12 ± 0.6	1.20 ± 0.05	1.19 ± 0.05	<b>0.001</b>	<b>0.003</b>	0.354
<b>Stride Time (sec)</b>	1.09 ± 0.02	1.06 ± 0.02	1.07 ± 0.02	<b>0.025</b>	<b>0.006</b>	0.517
<b>Stride Time Variability (%)</b>	3.52 ± 0.44	2.72 ± 0.24	3.08 ± 0.32	<b>0.028</b>	0.395	0.551
<b>Timed Up &amp; Go (sec)</b>	10.3 ± 0.6	9.4 ± 0.5	9.9 ± 0.6	<b>0.004</b>	0.206	<b>0.03</b>
*Entries are mean±SE. P-values						



**Table 3: Shorer et al<sup>17</sup>**

Effect of Single Dose Methylphenidate (MPH) on Postural Stability Parameters Under Single- and Dual-Task

Conditions (i.e., eyes closed narrow base stance)

Postural Stability Variables	Group	Baseline	Post-Test	ANOVA (baseline to post-test) <i>T</i>	ANOVA (baseline to post-test) <i>T X G</i>
<b>Single Task</b>					
<b>AP sway range (mm)</b>	Experimental Control	34.5 ± 7.8 31.7 ± 8.2	34.7 ± 7.5 30.8 ± 5.7	F = 0.29; p = 0.6	F = 0.45; p = 0.51
<b>ML sway range (mm)</b>	Experimental Control	41.1 ± 7.2 35.8 ± 8.5	39.3 ± 7.1 34.3 ± 8.5	F = 3.9; p = .057	F = 0.02; p = 0.89
<b>Mean velocity (mm<sup>2</sup>/s)</b>	Experimental Control	34.7 ± 11.4 33.1 ± 11.5	32.9 ± 9.7 31 ± 8.5	<b>F = 4.5; p = 0.04</b>	F = 0.5; p = 0.8
<b>Sway area (mm<sup>2</sup>)</b>	Experimental Control	132.3 ± 51.8 118.7 ± 58.7	123.7 ± 41 107.7 ± 40.7	<b>F = 4.0; p = 0.05</b>	F = 0.06; p = 0.81
<b>Cognitive task errors</b>	Experimental Control	0 0	0 0	NA	NA
<b>Dual Task</b>					
<b>AP sway range (mm)</b>	Experimental Control	42.6 ± 9.6 35.5 ± 6.6	41.9 ± 9.3 37.1 ± 6.5	F = 0.28; p = 0.6	<b>F = 1.7; p = 0.05</b>
<b>ML sway range (mm)</b>	Experimental Control	51.4 ± 9.4 42.3 ± 8.9	48.1 ± 8.2 40.4 ± 9.2	<b>F = 6.3; p=0.016</b>	F = 0.46; p = 0.5
<b>Mean velocity (mm<sup>2</sup>/s)</b>	Experimental Control	39.6 ± 11.7 34.7 ± 10.4	36.2 ± 9.9 31.9 ± 8.8	<b>F = 19.6; p = 0.001</b>	F = 0.19; p = 0.7
<b>Sway area (mm<sup>2</sup>)</b>	Experimental Control	183 ± 64.7 141.1 ± 49.8	163.7 ± 53.4 133 ± 51.2	<b>F = 10.6; p = 0.003</b>	F = 1.8; p = 0.19
<b>Cognitive task errors</b>	Experimental Control	5.2 ± 4.7 3.2 ± 2.3	2.8 ± 3.1 3.0 ± 1.6	F = 2.8; p = 0.1	F = 2.0; p = 0.17

Note: AP = anteroposterior; ANOVA = analysis of variance; G = group; NA = not applicable; ML = mediolateral; *T* = time.

Values are  $M \pm 1$  SD. Comparison of baseline and postintervention between the two groups based on repeated measures ANOVA ( $T \times G$ ).

**Table 4: Shorer et al<sup>17</sup>**

Effect of Single Dose Methylphenidate (MPH) on 6-m Narrow Base Walking Parameters Under Single-Task Condition (panel A) and Dual-Task Conditions (panel B)

Gait Variable	Group	Baseline	Post-Test	ANOVA (baseline to post-test) <i>T</i>	ANOVA (baseline to post-test) <i>T X G</i>	ANOVA (baseline to post-test) <i>T X Tr</i>
<b>Panel A; Single task</b> <b>Trial velocity (m/s)</b>	Experimental Control	0.82 ± 0.3 0.77 ± 0.2	0.88 ± 0.3 0.83 ± 0.25	F = 2.7; p = 0.1	F = 0.002; p = 0.97	F = 1.1; p = 0.2
<b>Trial time (s)</b>	Experimental Control	8.4 ± 3.4 8.6 ± 3.1	6.9 ± 2.2 7.8 ± 2.5	F = 8.3; p = .007	F = 1.0; p = 0.3	F = 0.9; p = 0.4
<b>Number of step errors</b>	Experimental Control	1.6 ± 1.2 2.0 ± 3.3	0.7 ± 0.8 1.9 ± 2.7	F = 3.7; p = 0.06	<b>F = 4.5; p = 0.04</b>	F = 1.7; p = 0.2
<b>Cognitive task errors rate (%)</b>	Experimental Control	0.6 ± 2.4 0.04 ± 0.01	0.05 ± 0.01 0 ± 0	F = 0.49; p = 0.48	F = 0.896; p = 0.37	F = 3.5; p = 0.04
<b>Panel B: Dual task (average value)</b> <b>Trial velocity (m/s)</b>	Experimental Control	0.61 ± 0.3 0.56 ± 0.2	0.71 ± 0.3 0.59 ± 0.25	F = 8; p = 0.008	<b>F = 5.2; p = 0.04</b>	F = 2.3; p = 0.05
<b>Trial time (s)</b>	Experimental Control	12.7 ± 7 12.0 ± 4.5	10.1 ± 4.9 12.0 ± 5.2	F = 4.1; p = 0.05	<b>F = 6.1; p = 0.02</b>	F = 0.16; p = 0.85
<b>Number of step errors</b>	Experimental Control	2.2 ± 1.9 2.6 ± 1.4	0.98 ± 1.1 2.3 ± 3.1	F = 1.1; p = 0.03	<b>F = 5.7; p = 0.02</b>	F = 3.3; p = 0.04
<b>Cognitive task errors rate (%)</b>	Experimental Control	0.02 ± 0.03 0.06 ± 0.16	0.01 ± 0.015 0.003 ± 0.007	F = 0.6 ; p = 0.4	F = 1.7; p = 0.21	F = 4.2; p = 0.03

Note: ANOVA = analysis of variance; G = group; T = time; Tr = trial number.  
The average of all three trials is presented. Values are M ± 1 SD (95% confidence interval for means). Comparison of baseline and post-intervention between the two groups based on repeated measures ANOVA (Test x Group x Trial condition).